MOVEMENTS, POPULATION FLUCTUATIONS, AND MORTALITY AMONG GREAT HORNED OWLS

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In his studies of the survival of banded birds, Hickey (1952) used certain recovery records of Great Horned Owls (*Bubo virginianus*) available on 30 July 1946 for development of a life table and other statistics. However, Hickey considered his analysis of the mortality rate of Great Horned Owl to be preliminary and indicated that a further analysis should be made when more data would have accumulated. The present paper includes some more recent data in a life table and in addition summarizes available information on travels of the birds, population fluctuations, and causes of mortality.

This analysis of North American recovery records of Great Horned Owls is based on data from 434 banding recoveries on file with the U.S. Fish and Wildlife Service on 30 November 1962. The birds were banded in 45 states and provinces and recovered in 46. Banding and recovery localities extended from Nova Scotia to California and from central Alberta to Florida. Relatively large numbers of birds were banded in Ohio, Wisconsin, Saskatchewan, New York, and Michigan. Eighty-nine of the 434 birds were banded as adults, 82 as immatures, 205 as juveniles, nestlings or locals, and 58 were unidentified as to age at banding.

For the development of a life table, a class of young birds was formed from those identified as juveniles, nestlings, and locals, the immatures being excluded because of uncertainty of the identification and meaning of this age class. Some birds were undoubtedly identified as adults when they were in fact less than one year of age. The term "direct recovery" is used in this paper to indicate that no more than one migration season intervened between banding and recovery dates. A bird constituting an indirect recovery could have participated in both a departing and returning migration. Arbitrarily, recoveries less than 50 miles from the banding places were dismissed as insignificant local movements, in part because of occasional uncertainties as to the exact locations of banding or recovery.

Data from the Christmas bird counts for 1949–65 as published in Audubon Field Notes (1950–66) were examined in search of evidence of cyclic fluctuations in Great Horned Owl populations, although Stewart (1954) indicated limitations to usefulness of the Christmas bird count data. Granting that these counts leave much to be desired as a scientific method for examining bird population trends, it seems that the data should be sensitive enough to indicate the presence or absence of cycles or major fluctuations in the population.

MOVEMENT

The locations of the recovery records of banded Great Horned Owls suggest that it is relatively unusual for these birds to make long-distance flights, but some such flights are made. Of the 434 recovery records, 405 (93 per cent) were of birds taken within 50 miles of the banding sites. Of the 29 birds recovered more than 50 miles from the banding sites, 16 had traveled more than 100 miles, 7 more than 200 miles, 5 more than 300 miles, 3 more than 400 miles, 1 more than 800 miles. The longest recorded flight was approximately 860 miles from central Alberta to southeastern South Dakota. Some of the 434 birds, however, were killed so soon after banding that they had little opportunity to travel. Of the 434 birds, 379 (87 per cent) were still alive at the end of one month after banding; 330 (76 per cent) were alive at the end of three months. Of the 330 birds surviving at least three months after banding, only the 29 (9 per cent) were recovered more than 50 miles from the banding sites.

In the case of birds recovered after two or more migration seasons passed, recovery at the banding sites, of course, does not mean that the birds had not participated in a migration. It seems likely, though, that only a part of the birds moved southward in any one winter. In central Alberta, 21 recoveries were taken with all seasons represented as follows: winter, 2; spring, 7; summer, 3; fall, 9.

Fewer southern than northern birds made long-distance travels. Of 23 birds banded in central Alberta, 6 (26 per cent) traveled more than 50 miles; of 43 banded in central Saskatchewan, 9 (21 per cent) traveled more than 50 miles; of 48 banded in Ohio, 2 (4 per cent) traveled more than 50 miles; of 32 banded in Michigan none traveled more than 50 miles. In the area south of 50° N and west of 80° W there were 202 birds banded, and only five traveled more than 50 miles between the banding and recovery sites. Of these five birds only two traveled more than 100 miles.

Of the 15 Great Horned Owls traveling 50 miles or more after being banded in central Alberta and Saskatchewan, four traveled in a north-south direction; ten traveled in a northwest-southeast direction; one traveled in an east-west direction. Of four birds traveling 50 miles or more after being banded in New York, all traveled in an east-west direction. Two birds traveled more than 100 miles after being banded in the central United States, but they traveled in the wrong season or direction so that migration was not indicated. Great Horned Owls appear not to perform regular north-south migrations but rather to disperse in all directions (Fig. 1).

Young Great Horned Owls may be more prone to travel than adults, for all except two of the ten direct long distance recoveries were of young birds. It must be recalled, however, that a total of 89 birds were banded as adults and

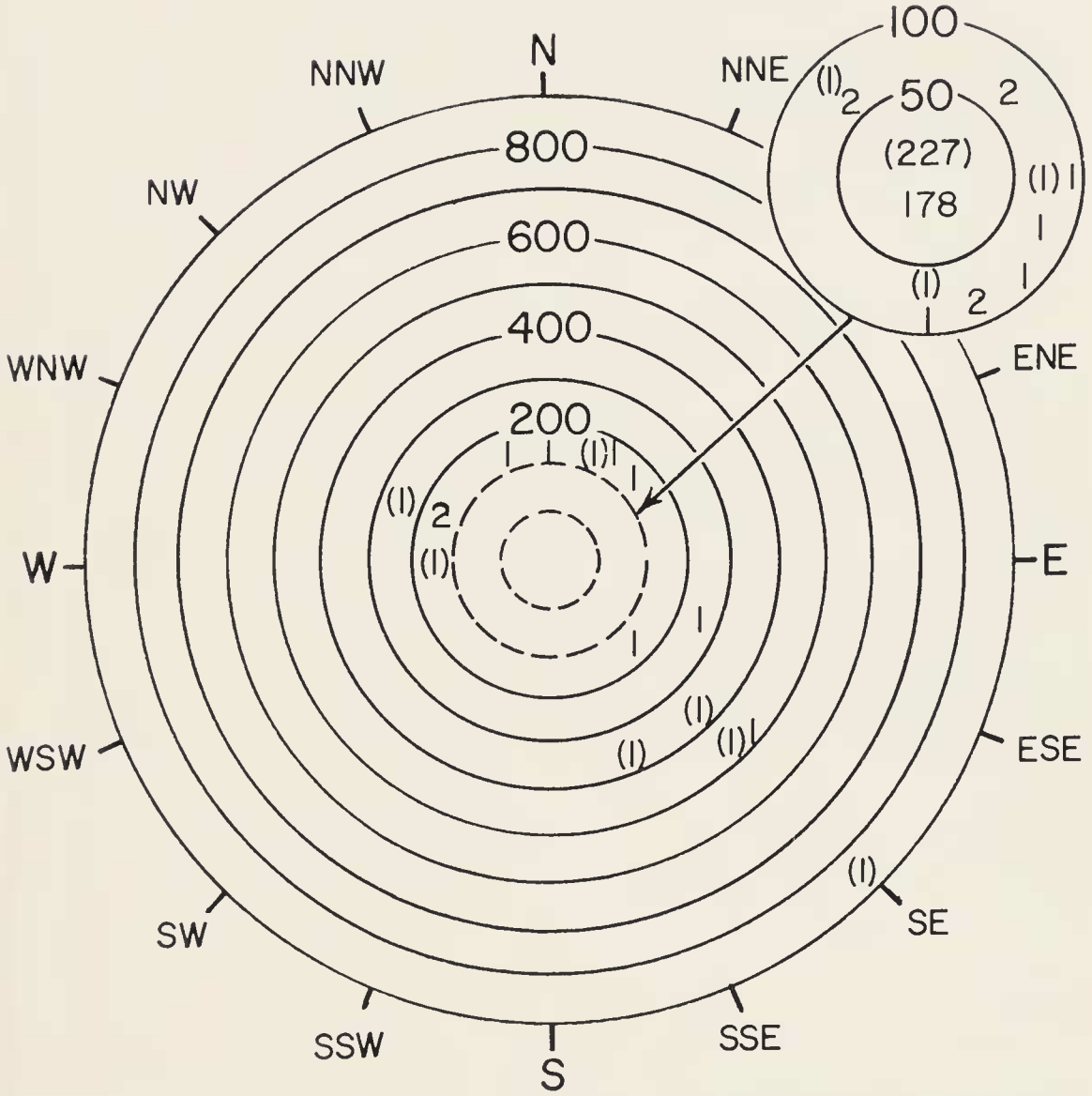

Fig. 1. Movements of Banded Great Horned Owls in Relation to their Banding Places. Distances of movement in miles are indicated by the concentric circles. The numbers of birds moving the various directions are indicated by the numbers between the circles. Numbers for direct recoveries are inclosed in parentheses; indirect recoveries are unmarked.

287 as young birds, so the probability of recoveries was different for the two age groups. All owls taken as direct recoveries and making fairly long-distance movements from central or southern Alberta and Saskatchewan were young birds. In Alberta and Saskatchewan six birds were banded as adults and 61 as young, so again the probability of recoveries of birds banded as adults was much smaller than for young. Only direct recoveries are considered here because when sufficient time had elapsed to get indirect recoveries all of the birds would have attained adult status.

Among the indirect recoveries of Great Horned Owls banded as young in central and southern Alberta and Saskatchewan, there was one bird recovered in central Minnesota on 17 December 1957, 500 miles southeast of the site where it was banded on 24 May 1956. This bird could have made its southward flight in either its first or second year, but if the flight were made in the second year, this would be the only adult making such an extended trip.

That there may have been unusually heavy southward movements of Great Horned Owls during 1916–18 was suggested by Bowles (1918) who reported large numbers in Washington in the falls of 1916 and 1917, by Brockway (1918) who reported large numbers in Connecticut in the winter of 1917–18, and by Soper (1918) who reported large numbers in southern Ontario in the winter of 1917–18. Apparently, none of these reports involved subspecies more northern than those native to the respective regions.

Taxonomists recognize ten races of Great Horned Owls in North America (A.O.U. 1957:277–279) and the fact that this species shows such diversity suggests that either it is relatively sedentary or has a tendency to return to its hatching place to breed. In observations in Kansas, Baumgartner (1939: 282) found that Great Horned Owls remained at their nesting sites throughout the year, except possibly for a few months in late summer and fall. In Michigan, Craighead and Craighead (1956:82) made observations indicating that birds paired during the fall and early winter and then remained at their nesting sites throughout the prenesting period.

POPULATION FLUCTUATIONS

Southland invasions by northern birds of prey usually are assumed to be associated with food scarcity in the North. The chief food of the Great Horned Owl in Canada is the varying hare (*Lepus americanus*) (Errington, et al., 1940:785), and North American populations of this cyclic species were at a low level in the period 1916–18 (Leopold, 1933:65). Speirs (1939:412) reported southward flights of Great Horned Owls during 1916–18, 1925–27, and 1936–38. A 9–11 year cycle was thus suggested. Presumably following Speirs, other authors (Hickey, 1943:76–77; Lack, 1954:209; Dasmann, 1963:148) have reported cyclic fluctuations in the Great Horned Owl population. However, differences of opinion are recorded in the literature as to whether Great Horned Owl populations actually are cyclic. Van Tyne and Berger (1959:178) indicated that the Great Horned Owl is one of several species making "great southward invasions at intervals without evidence of regular cycles."

The Christmas bird counts show no indication of a 9–11 year cycle in the Great Horned Owl population during 1949–65. Likewise no "great southward

TABLE 1

DYNAMIC LIFE TABLE FOR 97 GREAT HORNED OWLS BANDED AS NESTLINGS, JUVENILES AND LOCALS BEFORE 1951 AND RECOVERED BEFORE 30 NOVEMBER 1962

Age in years	Alive at start	No. deaths	Per cent mortality per year
0–1	97	45	46
1–2	52	21	40
2–3	31	9	29
3–4	22	7	32
4–5	15	4	27
5–6	11	2	18
6–7	9	2	22
7–8	7	2	29
8–9	5	2	40
9–10	3	2	67
10–11	1	0	0
11–12	1	0	0
12–13	1	0	0
13–14	1	1	100
Total and mean		97	32

invasion" was shown. While more than three times as many birds were observed in the Christmas bird counts during 1963 as during 1951, much of the difference between low and high levels resulted from a steady increase in numbers of birds observed each year. This steady increase in totals of Great Horned Owls observed on the 51 Christmas bird counts that were examined probably resulted chiefly from a growing increase in efforts of observers to run up large totals of birds to be reported, rather than from population increase. Chandler S. Robbins (pers. comm.) confirmed that there has been increasing effort to find Great Horned Owls in at least two of the counts used in this study.

MORTALITY

A life table was constructed from recovery records of 97 Great Horned Owls banded before 1951 as juveniles, nestlings, and locals. Of these 97 birds, 45 (46 per cent) died within the first year after banding. The mean annual mortality rate after the first year was 31 per cent (Table 1); the mean annual mortality rate after the second year was 30 per cent. With a sample of 58 recoveries, Hickey (1952:116) determined a first-year mortality rate of 51 per cent and an average annual mortality rate after the first year of 23 per cent.

In comparing Hickey's calculated mortality rates with rates calculated in this study, it must be pointed out that slightly different methods of

analysis were used. Hickey used an abridged life table constructed from banding totals of all banders who had banded later-recovered nestling Great Horned Owls. The subsequent fates of banded birds were followed through the recovery reports. Data of banders not obtaining recoveries were ignored, thus giving a slight bias toward a higher mortality rate. Hickey's base sample was of birds banded, some of which were not recovered. I used a dynamic life table, as described by Hickey (ibid.:10). My sample included only birds which were recovered, the recovered sample being classified as to the length of life of the birds.

Adult birds appear to have a higher probability than young of being recovered soon after banding. Nine of 80 adults (11 per cent) were recovered in the first week after banding; 4 of 205 young (2 per cent) were recovered in the first week. In the first two months after banding, 39 per cent of the adults and 13 per cent of the young were recovered. These data suggest either that the adult birds may have had some attribute of health or behavior which made them susceptible to capture, first for banding and subsequently for recovery, or that the initial capture for banding made them more easily captured a second time.

One of the banded Great Horned Owls lived 4 years longer than any of the others, or until it was 13–14 years of age. This bird was banded in Iowa on 23 April 1939 and recovered near the banding site on 6 October 1952. Even this 13–14 years of life was less than half the potential life span for the species, for Bent (1938) reported a male Great Horned Owl kept in captivity for 29 years. A captive Eagle Owl (*Bubo bubo*) in Europe was reported by Gunston (1964:114) to have reached the age of 68 years—seemingly the age record for an owl. The loss of bands is undoubtedly an important factor limiting the recorded life spans of wild-living Great Horned Owls.

Information on the causes of death was available for 374 Great Horned Owls. As the deaths of all of these 374 birds were reported by humans and thus each bird came into human hands, this is a biased sample of mortality causes. Shooting was clearly the chief cause of death of birds in this sample, 52 per cent being reported shot. In addition to these, another 8 per cent were reported as injured when found, and most of the injuries may have resulted from shooting. Still another 99 birds (27 per cent) were found dead, and some, perhaps most or all of these, may have been shot—perhaps shot by one person and found dead by another. As many as 322 of the 374 birds (86 per cent) may have died from shooting. Another 37 birds (10 per cent) were trapped and killed. One bird was caught by hand and killed. Of the 374 birds, 360 (96 per cent) may have died from intended killing by man.

Among factors each responsible for death of 2 per cent or less of birds in

the sample, being killed by an automobile was the leading factor, accounting for the deaths of six birds (2 per cent). Entanglement in string or wire was responsible for the deaths of two birds and electrocution for one. Only 4 birds (1 per cent) were killed in ways that appeared to have been natural; flying into an object (2 birds), starved (1 bird), avian predator (1 bird).

SUMMARY

A study was made of movement and mortality of Great Horned Owls through use of 434 recovery records of banded birds on file with the U.S. Fish and Wildlife Service on 30 November 1962. Population trends were studied with use of the Audubon Field Notes Christmas bird counts from 51 localities for the period 1949–65.

The banding data indicate that some Great Horned Owls disperse in all directions in the fall and winter, but most remain near their hatching and breeding places throughout the year. Banding recoveries from the northern part of the bird's range were available only from Alberta and Saskatchewan, and movement from this region was chiefly southeastward. The longest flight was approximately 860 miles. Movement was confined to young birds. There was less movement in the southern than in the northern part of the range.

Most recovered Great Horned Owls were intentionally killed my man, chiefly by shooting. First year mortality of young birds was 46 per cent; mean annual mortality after the first year was 31 per cent. The oldest bird lived to be between 13 and 14 years of age. The Christmas bird count data give no indication of major fluctuations, cyclic or otherwise, in the Great Horned Owl population during 1949–65.

ACKNOWLEDGMENT

I am grateful to Allen J. Duvall for making available to me all of the banding recovery records of Great Horned Owls and for a critical reading of this manuscript. Joseph J. Hickey, Brooke Meanley, Helmut C. Mueller, and Chandler S. Robbins also read the manuscript and offered valuable suggestions for its improvement. The help of Alfred J. Godin in preparing Figure 1 is gratefully acknowledged. The feasibility of using statistical tests for analysis of data in this paper was discussed with Robert G. Heath, and he is to be credited with the adopted procedure. The U.S. Fish and Wildlife Service aided in the typing of the manuscript. The many persons who banded Great Horned Owls or reported the owls' recoveries to the U.S. Fish and Wildlife Service performed services essential to this study, but space limitations clearly forestall individual acknowledgment. Likewise, the necessary contribution of a host of observers on Christmas bird counts cannot be individually acknowledged.

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